WHAT WE CLAIM ARE:

1. A method of manufacturing a semiconductor device comprising the steps of:

(a) forming a mushroom gate on a semiconductor substrate, the mushroom gate traversing an active region of the semiconductor substrate and having a fine gate and an over gate formed on the fine gate and constituting an electrode portion having a broadened size along a current direction;

(b) coating a first organic material film on the semiconductor substrate, the first organic material film covering at least the fine gate and a lower surface of the over gate of the mushroom gate;

(c) patterning the first organic material film and leaving the first organic material film only near at the mushroom gate;

(d) coating a second organic material film having chemical characteristics different from chemical characteristics of the first organic material film, the second organic material film covering the left first organic material film;

(e) forming an opening through the second organic material film to expose the first organic material film; and

(f) dissolving and removing the first organic material film via the opening to form a hollow space in the second organic material film.

2. A method of manufacturing a semiconductor device according to claim 1, wherein:

said step (b) forms the first organic material film covering the whole of the mushroom gate; and

said step (c) comprises steps of:

(c-1) forming a mask on the first organic material film above the

mushroom gate in the active region; and

(c-2) by using the mask, etching the first organic material film.

3. A method of manufacturing a semiconductor device according to claim 2, wherein said step (c-1) forms the mask covering an upper surface of the over gate on a source side and not covering the upper surface of the over gate on a drain side in the active region.

4. A method of manufacturing a semiconductor device according to claim 1, further comprising after said step (c) a step of:

(x) fluidizing the first organic material film.

5. A method of manufacturing a semiconductor device according to claim 4, wherein said step (x) is executed after said step (d) to fluidize also the second organic material film.

6. A method of manufacturing a semiconductor device according to claim 4, wherein said step (a) comprises:

(a-1) forming a resist lamination structure having a lower resist layer and an upper resist layer on the semiconductor substrate:

(a-2) exposing an over gate pattern in the upper resist layer;

(a-3) exposing a fine gate pattern in the lower resist layer;

(a-4) performing auxiliary exposure at an exposure amount smaller than an exposure amount of said step (a-3) to the lower resist layer, the auxiliary exposure traversing a span of the over gate pattern along the current direction in

a partial area of the over gate pattern;

(a-5) developing the resist lamination structure subjected to the exposure and auxiliary exposure to pattern the upper resist layer having an opening of the over gate pattern and the lower resist layer having an opening of the fine gate pattern and an over gate lowering region having an upper surface being lowered by the auxiliary exposure;

(a-6) depositing a gate electrode layer on the patterned resist lamination structure; and

(a-7) lifting off the gate electrode layer on the resist lamination structure to leave the mushroom gate.

7. A method of manufacturing a semiconductor device according to claim 6, wherein:

said step (a) forms also a gate pad continuous with the mushroom gate in an area outside of the active region;

said step (e) forms an opening above the gate pad; and

the method further comprises after said step (f) a step of:

(g) depositing a metal film above the second organic material film to seal the hollow space.

8. A method of manufacturing a semiconductor device according to claim 6, wherein said step (a-3) does not expose the fine gate pattern in a selected area outside of the active region and said step (e) forms the opening in an area near the selected area.

9. A method of manufacturing a semiconductor device according to claim 1, wherein:

the method further comprises a step of:

(y) etching the semiconductor substrate to a predetermined depth to form a recess in an area outside of the active region and nearer to the active region than a region where the opening is formed; and

said step (f) forms the hollow space rising from the recess toward the active region.

10. A method of manufacturing a semiconductor device according to claim 1, wherein the first organic material film is made of polymethylglutarimide.

11. A method of manufacturing a semiconductor device according to claim 1, wherein the second organic material film is made of benzocyclobutene.

12. A method of manufacturing a semiconductor device according to claim 1, wherein said step (f) includes wet etching using N-methyl-2-pyrrolidinone.

13. A semiconductor device comprising:

a semiconductor substrate having an active region;

a mushroom gate formed on said semiconductor substrate and traversing the active region, said mushroom gate having a fine gate and an over gate formed on the fine gate and having a broadened size along a current direction;

an organic material film defining a hollow space, the hollow space

surrounding at least side surfaces of the fine gate and a lower surface of the over gate respectively of said mushroom gate in the active region, and the hollow space having a curved surface at an interface thereof; and

an opening reaching the hollow space from an upper surface of said organic material film in an area outside of the active region.

14. A semiconductor device according to claim 13, wherein the hollow space covers the whole of said mushroom gate in the active region.

15. A semiconductor device according to claim 13, wherein the hollow space surrounds a source side region of said mushroom gate and touches a lower surface of the over gate, and an upper surface of the over gate of said mushroom gate on a drain side contacts said organic material film.

16. A semiconductor device according to claim 13, wherein the hollow space occupies a region under the over gate of said mushroom gate and said organic material film covers an upper surface of the over gate.

17. A semiconductor device according to claim 13, wherein the hollow space has a lower height at opposite end portions outside of the active region and the opening communicates with the hollow space at the lower height opposite end portions.

18. A semiconductor device according to claim 13, wherein a lower surface of the over gate of said mushroom gate has a lowered height in a partial region

outside of the active region, and the height of the hollow space under the over gate is lowered.

19. A semiconductor device according to claim 18, wherein said opening communicates with a region of the hallow space where the height of the lower surface of the over gate is lowered.

20. A semiconductor device according to claim 13, further comprising a metal layer formed on an inner surface of said opening, said metal layer sealing said hollow space.

21. A semiconductor device according to claim 13, wherein said mushroom gate has a region without the fine gate under the over gate in an area outside of the active region.

22. A semiconductor integrated circuit device comprising:

a semiconductor substrate having a plurality of active regions;

a plurality of mushroom gates formed on said semiconductor substrate, each of said mushroom gates traversing a corresponding one of said active regions, said mushroom gate having a fine gate and an over gate formed on the fine gate and having a broadened size along a current direction;

an organic material film defining a plurality of hollow spaces, the hollow space surrounding at least side surfaces of the fine gate and a lower surface of the over gate respectively of said mushroom gate in the active regions, the hollow space having a curved surface at an interface thereof; and

a plurality of openings each reaching a corresponding one of the hollow spaces from an upper surface of said organic material film in an area outside of the active region.